EPILEPTIC SEIZURE PREDICTION

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ABSTRACT

Epilepsy is a very common neurological disease that has affected more than 65 million people worldwide. In more than 30 % of the cases, people affected by this disease cannot be cured with medicines or surgery. However, predicting a seizure before it actually occurs can help in its prevention; through therapeutic intervention. Studies have observed that abnormal activity inside the brain begins a few minutes before the start of a seizure, which is known as preictal state. This study proposes a novel approach for detecting epileptic seizures from electroencephalogram (EEG) data obtained from both normal subjects and epileptic patients. EEG data contains crucial information reflecting various physiological states of the brain. Our method involves employing hierarchical clustering techniques for seizure detection. We evaluated several models for this task, including CNN+SVM, VGG16, DenseNet121, MobileNetV2, and Xception. Remarkably, DenseNet121 achieved more accuracy, followed closely by VGG16, and MobileNetV2. Followed by Xception and then CNN+SVM model. Despite DenseNet121's higher accuracy, the CNN+SVM model was selected for implementation due to its superior F1 score, precision, and recall.

Keywords: Epilepsy Prediction, Seizures, Preictal state, Deep learning, Scalp EEG.

INTRODUCTION

Epilepsy is a neurological disorder characterized by recurrent seizures, affecting approximately 50 million people worldwide. Early and accurate detection of seizures is crucial for effective management and intervention strategies. Electroencephalography (EEG) has emerged as a valuable tool for monitoring brain activity and detecting seizure onset. Conventional EEG analysis often involves manual inspection by trained professionals, which can be time-consuming and subjective. Consequently, there is a growing interest in developing automated seizure detection methods to improve efficiency and reliability. Convolutional Neural Networks, renowned for their success in image processing, are employed to extract intricate patterns from Electroencephalogram (EEG) data. Following the CNN feature extraction, the Support Vector Machine comes into play as a classifier. SVMs are renowned for their effectiveness in distinguishing between different classes. In this application, SVMs are trained on the extracted features to discern the subtle patterns that precede epileptic seizures from normal brain activity. This combination of CNNs for feature extraction and SVMs for classification creates a robust model capable of predicting seizures with high accuracy. This combination of CNN and SVM creates a synergistic model that excels in predicting epileptic seizures with high accuracy.

LITERATURE SURVEY

"An Effective Cluster-Based Outlier Detection with Optimized Deep Neural Network for Epileptic Seizure Detection and Classification Model" [1]: Epileptic seizure diagnosis using Electroencephalogram (EEG) signal is an essential process in the healthcare sector to detect the abnormal growth of brain activities. Since epileptic seizure detection by physicians requires more time, it is needed to design an automated epileptic detection model. Due to the advancements in the Deep Learning (DL) models, it can be employed in the diagnosis of epileptic seizures from EEG signals. This paper presents a new hierarchical clustering with adaptive momentum (ADAM) optimized Deep Neural Network (DNN), called the HC-DNN-ADAM model. The presented model involves HC-based outlier detection to remove the unwanted data from the input dataset; thereby, the classifier results can be improved. In addition, the HCDNN-ADAM model utilizes DNN for the classification process where the hyperparameters of DNN are tuned by ADAM optimizer. For examining the effectual classifier results analysis of the HC-DNN-ADAM model, a benchmark Epileptic Seizure Recognition dataset is utilized. The application of HC and ADAM paves a way to achieve better classification outcomes. The performance of the HC-DNN-ADAM model has been validated using a benchmark dataset. The simulation outcomes signified that the HC-DNN-ADAM model has resulted in maximum detection performance with an accuracy of 99.74% on the classification of multiple classes of seizures.

"Automatic detection of epileptic seizures in EEG using discrete wavelet transform and approximate entropy" [2]: In this study, a new scheme was presented for detecting epileptic seizures from electro-encephaloma-gram (EEG) data recorded from normal subjects and epileptic patients. The new scheme was based on approximate entropy (ApEn) and discrete wavelet transform (DWT) analysis of EEG signals. Seizure detection was accomplished in two stages. In the first stage, EEG signals were decomposed into approximation and detail coefficients using DWT.

In the second stage, ApEn values of the approximation and detail coefficients were computed. Significant differences were found between the ApEn values of the epileptic and the normal EEG allowing us to detect seizures with over 96% accuracy. Without DWT as preprocessing step, it was shown that the detection rate was reduced to 73%. The analysis results depicted that during seizure activity EEG had lower ApEn values compared to normal EEG. This suggested that epileptic EEG was more predictable or less complex than the normal EEG. The data was further analyzed with surrogate data analysis methods to test for evidence of nonlinearities. It was shown that epileptic EEG had significant nonlinearity whereas normal EEG behaved similar to Gaussian linear stochastic process.

"Neural Networks with Periodogram and Autoregressive Spectral Analysis Methods in Detection of Epileptic Seizure"[3]: Approximately 1% of the people in the world suffer from epilepsy. Careful analyses of the electroencephalograph (EEG) records can provide valuable insight and improved understanding of the mechanisms causing epileptic disorders. Predicting the onset of epileptic seizure is an important and difficult biomedical problem, which has attracted substantial attention of the intelligent computing community over the past two decades. The purpose of this work was to investigate the performance of the periodogram and autoregressive (AR) power spectrum methods to extract classifiable features from human electroencephalogram (EEG) by using artificial neural networks (ANN).

The feedforward ANN system was trained and tested with the backpropagation algorithm using a large data set of exemplars. We present a method for the automatic comparison of epileptic seizures in EEG, allowing the grouping of seizures having similar overall patterns. Each channel of the EEG is first broken down into segments having relatively stationary characteristics. Features are then calculated for each segment, and all segments of all channels of the seizures of a patient are grouped into clusters of similar morphology. This clustering allows labeling of every EEG segment. Examples from 5 patients with scalp electrodes illustrate the ability of the method to group seizures of similar morphology. It was observed that ANN classification of EEG signals with AR preprocessing gives better results, and these results can also be used for the deduction of epileptic seizure

EXISTING SYSTEM

The existing system for detecting epileptic seizures from EEG data involves a two-stage process utilizing discrete wavelet transform (DWT) analysis and approximate entropy (ApEn) calculations. Initially, EEG signals are decomposed using DWT to derive approximation and detail coefficients. Subsequently, ApEn values are computed for these coefficients. Notably, significant distinctions in ApEn values between epileptic and normal EEG signals are observed, suggesting differing levels of complexity or predictability. These differences enable the identification of seizure activity. An artificial neural network (ANN), specifically a feed-forward back-propagation neural network, is employed for classification. The ANN's training algorithm utilizes the Levenberg–Marquardt optimization technique to adjust weight and bias values iteratively, optimizing the network's performance in distinguishing between epileptic and normal EEG patterns. This approach offers promise for robust and automated seizure detection in clinical settings.

PROPOSED SCHEME

The proposed system aims to develop an advanced epileptic seizure detection framework using electroencephalogram (EEG) data analysis. Leveraging hierarchical clustering techniques and deep learning models, such as CNN+SVM, VGG16, DenseNet121, MobileNetV2, and Xception, we intend to create a robust and efficient system. By integrating these models, we seek to enhance the accuracy and reliability of seizure detection, particularly in real-time scenarios. The system will utilize Flask as the frontend framework for user interaction and visualization. Through this system, medical professionals, caregivers, and patients will have access to a user-friendly interface for seamless EEG data processing and seizure detection. Ultimately, this proposed system aims to improve the diagnosis and management of epilepsy, leading to better treatment outcomes, reduced healthcare costs, and enhanced quality of life for individuals affected by this neurological disorder.

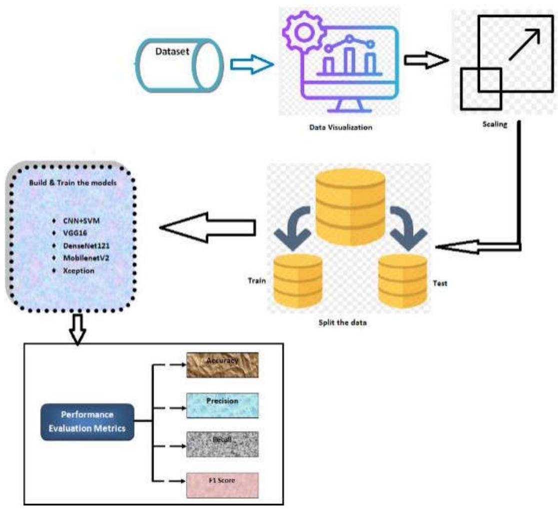

Fig 1: System Architecture

The Data Collection Module serves as the initial entry point, responsible for gathering EEG data from individuals with epilepsy. Following data collection, the Data Pre-processing takes charge of cleaning and preparing the EEG data for further analysis. Techniques such as noise removal, artifact correction, and normalization are applied to ensure the data's quality and consistency. This pre-processed data is then fed into the next stage for feature extraction. In the Feature Extraction and Model Generation, the CNN+SVM approach comes into play. Convolutional Neural Networks (CNNs) are utilized to extract relevant features from the pre-processed EEG data, capturing patterns indicative of seizure activity. These features are then fed into Support Vector Machines (SVMs), which learn to classify the data into preictal (seizure-prone) and interictal (non-seizure) states. The trained model is then ready for prediction. Finally, in the Prediction , the trained model is deployed to make real-time predictions on new EEG data. Users can input EEG recordings through a user interface, and the system provides predictions regarding the likelihood of an impending seizure.

OUTPUT SCREENS

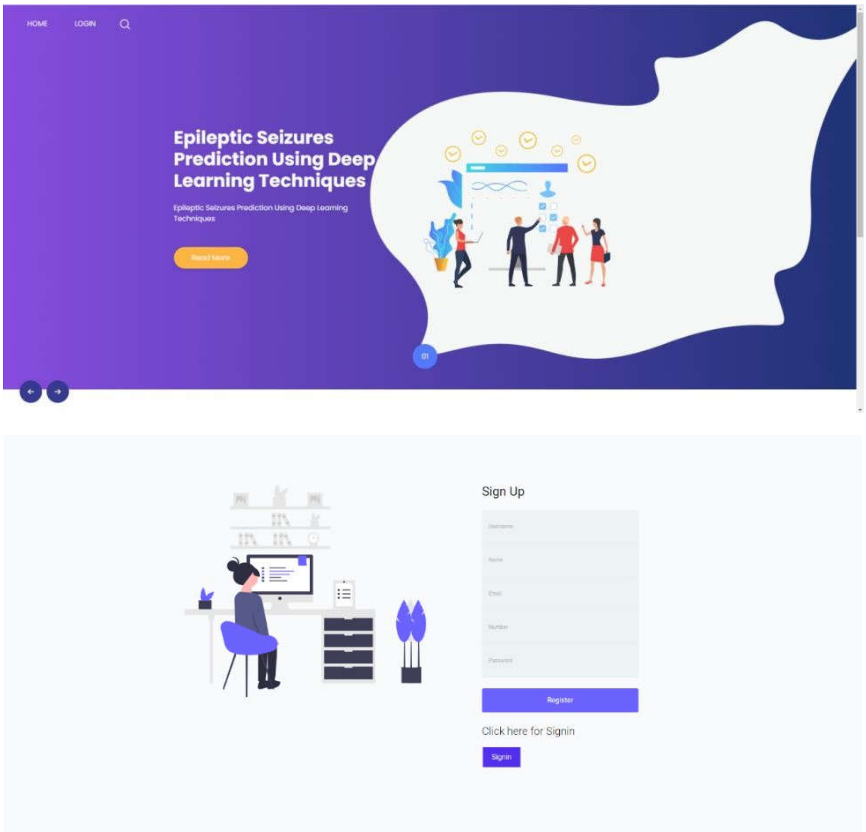

Fig 1: Registration Page

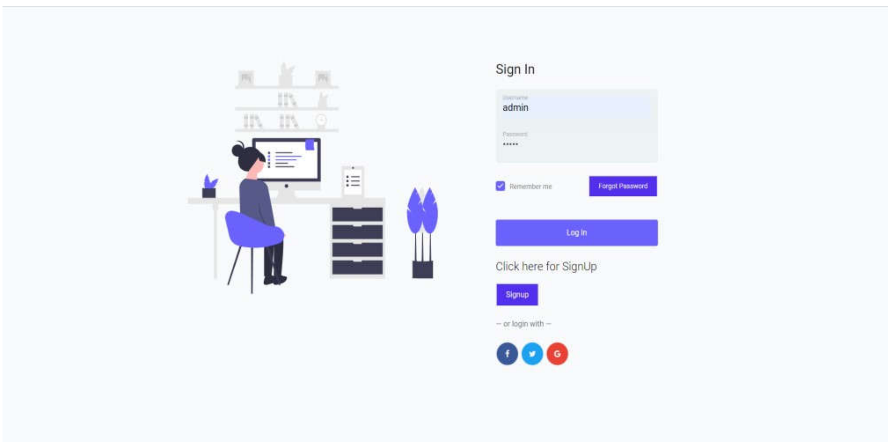

Fig 2: Login Page

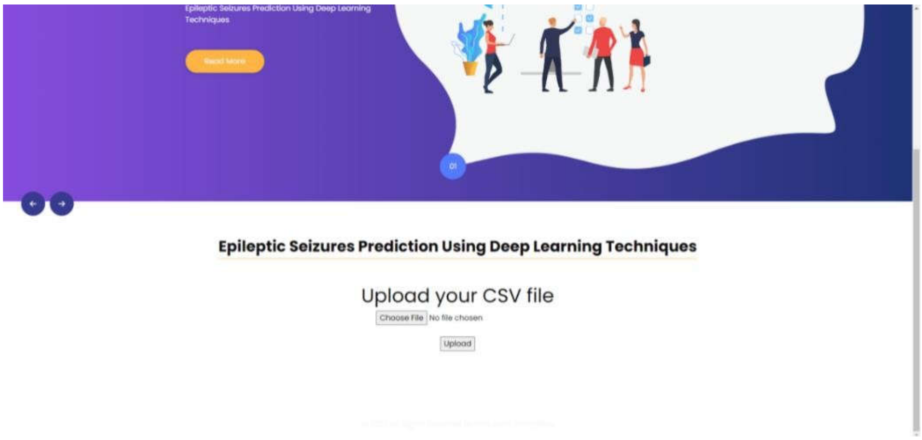

Fig 3: Upload Dataset

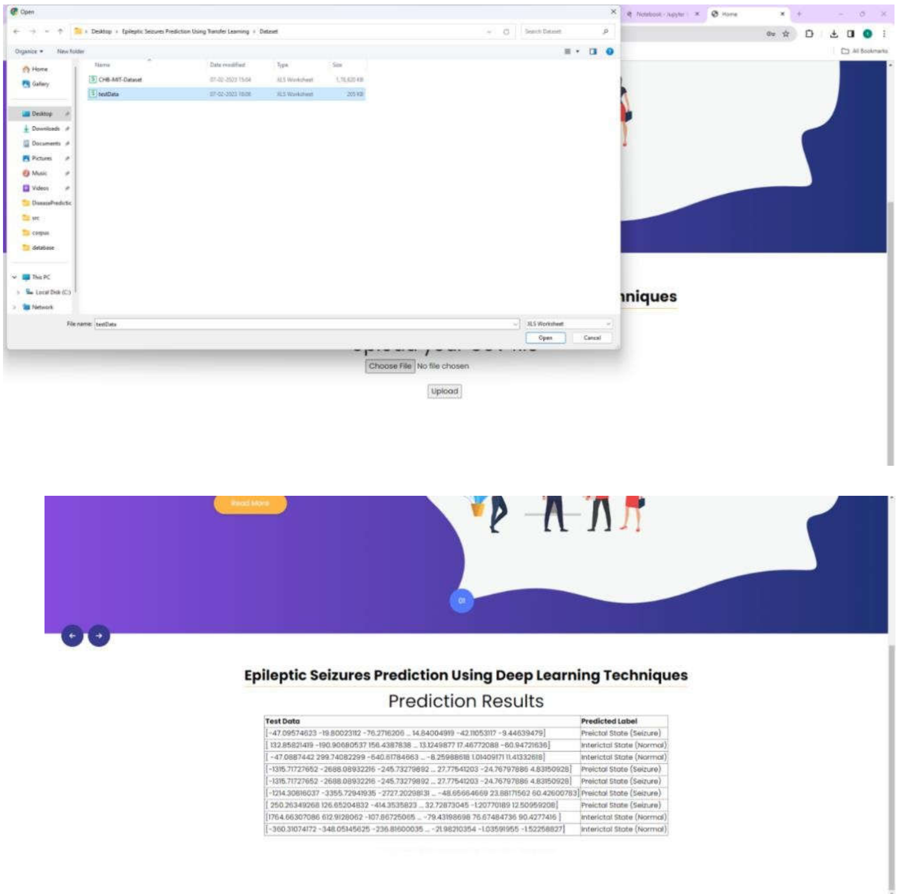

Fig 4 : Prediction Results

CONCLUSION

In conclusion, our study offers a comprehensive evaluation of various deep learning models for epileptic seizure detection using electroencephalogram (EEG) data. Through rigorous experimentation, including CNN+SVM, VGG16, DenseNet121, MobileNetV2, and Xception, we have obtained insightful results. Our findings underscore the efficacy of deep learning models, particularly CNN+SVM, in accurately identifying epileptic seizures from EEG data. Moreover, the integration of these models into a frontend application using Flask facilitates practical implementation, enabling real-time seizure detection for improved patient care. This research significantly contributes to the field of neurological disorder diagnosis and management by providing a reliable and efficient method for seizure detection. Future work may involve exploring ensemble learning techniques or incorporating additional preprocessing methods to further enhance the performance of seizure detection systems. Overall, our study highlights the promising role of deep learning in revolutionizing epilepsy diagnosis and treatment, benefiting both patients and healthcare providers.

REFERENCES

1. P. Suguna, B. Kirubagari, R. Umamaheswari, “An Effective Cluster-Based Outlier Detection with Optimized Deep Neural Network for Epileptic Seizure Detection and Classification Model,” published in Medicine, Computer Science, Engineering, international journal of engineering trends and technology.
2. Hasan O.: Automatic detection of epileptic seizures in EEG using discrete wavelet transform and approximate entropy. Expert Syst. Appl. 36, 52027–52036.
3. Kiymik M.K., Subasi A., Ozcalik H.R.: Neural networks with periodogram and autoregressive spectral analysis methods in detection of epileptic seizure. J. Med. Syst. 28(6), 511–522 (2004)
4. Adeli H., Zhou Z., Dadmehr N.: Analysis of EEG records in an epileptic patient using wavelet transform. J. Neurosci. Methods 123, 69–87.
5. Radhakrishnan N., Gangadhar B.: Estimating regularity in epileptic seizure time-series data: a complexity-measure approach. In: IEEE Eng. Med. Biol. 17(3), 89–94.
6. J. Liu, F. Li, W. Li, H. Jiang, and Z. Wang, "A flash ADC with low offset dynamic comparators," 2017 International Conference on Electron Devices and Solid-State Circuits, Hsinchu, 2017, pp. 1-2.
7. Guo L., Riveero D., Pazaos A.: Epileptic seizure detection using multiwavelet transform based approximate entropy and artificial neural networks. J. Neurosci. Methods 193, 156–163.